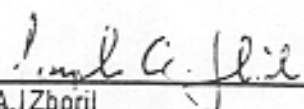




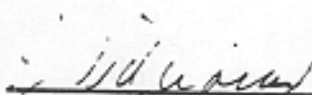
Advanced X-ray Astrophysics Facility

Safety Plan

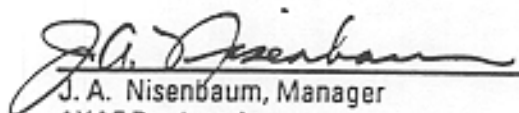
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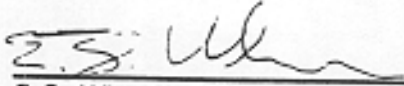

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ATO	Assembly and Test Operation
ASE	Airborne Support Equipment
AXAF	Advanced X-Ray Astrophysics Facility
ASWG	AXAF Safety Working Group
CAB	Corrective Action Board
CDR	Critical Design Review
CI	Configuration Item
EGSE	Electrical Ground Support Equipment
EKC	Eastman Kodak Company
FRR	Flight Readiness Review
GSFC	Goddard Space Flight Center
HDOS	Hughes Danbury Optical Systems
H&S	Health and Safety
ICD	Interface Control Document
IPI	Instrument Principal Investigator
JSC	Johnson Space Center
KSC	Kennedy Space Center
MGSE	Mechanical Ground Support Equipment
MIP	Mandatory Inspection Point
MSFC	Marshall Space Flight Center
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Act
ORI	Operational Readiness Inspection
PAR	Product Assurance Requirements (Document)
PDR	Preliminary Design Review
RMS	Remote Manipulator System
S&TG	Space and Technology Group
SAR	Safety Action Request
SHA	System Hazard Analysis
SI	Science Instrument
SRM&QA	Safety, Reliability, Maintainability, and Quality Assurance
SS	System Safety
SSE	Space Support Equipment
STE	Special Test Equipment (e.g., VETA-I)
STG	Space and Technology Group
STS	Space Transportation System
STP	Special Test Procedure
SRR	System Requirements Review
VETA	Verification Engineering Test Article
XRCF	X-Ray Calibration Facility

1.0 PURPOSE AND SCOPE

1.1 INTRODUCTION

The Advanced X-Ray Astrophysics Facility (AXAF) is a free flying X-ray observatory to be launched using the Space Transportation System (STS). From the STS point of view, the AXAF is considered to be a "nonreturnable" payload. In this plan, "AXAF" refers to AXAF-I (imaging). The AXAF will perform a five year mission, and is required to comply with NSTS 1700.7, KHB 1700.7 and other standards applicable to STS payloads and ground operations.

This plan is submitted in response to AXAF Data Procurement Document DR SA03. It is formatted in accordance with the sample outline provided in NHB 1700.1 (V7) and responds to the safety work scope specified in NHB 5300.4(1D-2), the AXAF Statement of Work, the AXAF Project Requirements Document.

1.2 PURPOSE

The purpose of this plan is to provide a planned and systematic program which identifies AXAF safety requirements and assures that full compliance with these requirements is achieved. The plan describes the system for defining risks and hazards and the methods to eliminate or control them. It includes both the management and technical approaches which will be used to implement safety requirements and to minimize risk to personnel and equipment. Specific objectives of this plan are to:

- o Provide the identification and control of hazards to personnel, facilities, support equipment and mission hardware during all stages of AXAF development, manufacture, assembly, test, and use.
- o Provide a risk management program that identifies and evaluates foreseeable and/or predictable risks.
- o Satisfy the applicable requirements of the documents listed in Section 2.

1.3 SCOPE

The AXAF Safety Plan describes safety tasks related to the following program activities:

- o Design and development
- o Manufacture
- o Assembly and test (including x-ray testing at the MSFC X-Ray Calibration Facility (XRCF))
- o Handling and transportation
- o Launch site operations

- o STS Operations
- o On-orbit operations/deployment
- o Abort and contingency operations

This plan integrates the safety activities of TRW, subcontractors, and suppliers into a single, comprehensive safety program. An Industrial Safety/Occupational Health Plan with provisions for compliance with Federal and California Occupational Safety and Health Standards and local ordinances is appended to this plan as Appendix B.

2.0 APPLICABLE DOCUMENTS

2.1 GOVERNMENT DOCUMENTS

NHB 1700.1(V7)	NASA Safety Manual
NHB 5300.4(1D-2)	Safety, Reliability, Maintainability and Quality Provisions for the Space Shuttle Program
NHB 6000.1C	Requirements for Packaging, Handling, and Transportation for Aeronautical and Space Systems, Equipment, and Associated Components
NHB 8060.1B	Flammability, Odor, and Outgassing Requirements and Test Procedures for Materials in Environments that Support Combustion
NHB 8071.1	Fracture control Requirements for Payloads Using the National space Transportation System
NSTS 1700.7B	Safety Policy and Requirements for Payloads Using the Space Transportation System
NSTS 14046B	Payload Verification Requirements
NSTS 13830B	Implementation Procedures for STS Payloads Systems Safety Requirements
NSTS 18798A	Interpretations of STS Payload Safety Requirements
KHB 1700.7A	Space Transportation System Payload Ground Safety Handbook
KMI 1860.1	Radiation Protection Program - Policies and General Provisions for Ionizing and Non-Ionizing Radiation
GP 1098E	KSC Ground Safety Plan, Launch Complex 30 and KSC Industrial Area, Volumes 1 and 2

MSFC-HDBK-505A	Structural Strength Design and Verification Program Requirements
MSFC-HDBK-527E	Materials Selection List for Space Hardware Systems
MSFC-HDBK-1453	Fracture Control Program Requirements
MSFC-SPEC-522B	Design Criteria for Controlling Stress Corrosion Cracking
MSFC-STD-126E	Standard Inspection, Proof Testing, and Certification of Handling Equipment
MSFC-STD-1249	Nondestructive Evaluation Guidelines and Requirements for Fracture Control Programs
MMI 1700.6D	MSFC Operations Readiness Program
MMI 1700.18	MSFC System Safety Program
MMI 1710.6	MSFC Program for Personnel Certification
MMI 1711.2D	Accident/Incident Investigation and Reporting
MMI 1860.4	Reporting Requirements for Minor Radioactive Sources
MMI 5310.2D	Alerts and Saf-Alerts Reporting
MMI 6400.2B	Packaging, Handling, and Moving Program Critical Hardware

2.2 TRW DOCUMENTS

- o System Safety Handbook, Volume 0
- o Health and Safety Manual, Practice 1.1, "Health and Safety Program"
- o Health and Safety Manual, Practice 2.5, "Accident Reporting, and Review - Personal Injury and Property Damage"
- o Packaging, Handling, and Transportability Engineering Manual
- o Assembly and Test Operation (ATO) Standard Practice Manual

3.0 SAFETY ORGANIZATION

3.1 AXAF PROGRAM ORGANIZATION

The ultimate responsibility for the conduct and overall implementation of the AXAF safety program rests with the program manager. He approves the safety plan and monitors its

implementation to assure safety-related issues are resolved and risks/hazards are eliminated or controlled.

The AXAF safety manager is the program manager's representative for safety and serves as the TRW focal point and authority for AXAF program safety matters. Organizationally, the safety manager reports to the product assurance manager (Figure 3-1). System safety program status and progress are reported by the product assurance manager to the program manager at bi-weekly staff meetings. Significant concerns are brought to the program manager's attention directly by the safety manager. It is TRW policy that the safety manager has unrestricted access to the program manager at any time. Safety program authority and independence is further enhanced by means of the AXAF Safety Working Group.

3.2 FUNCTIONAL ORGANIZATION SUPPORT

The AXAF safety manager is provided by and receives technical direction from the Reliability, Safety, and Configuration Management resource center. This functional unit provides highly-qualified specialists for program support activities.

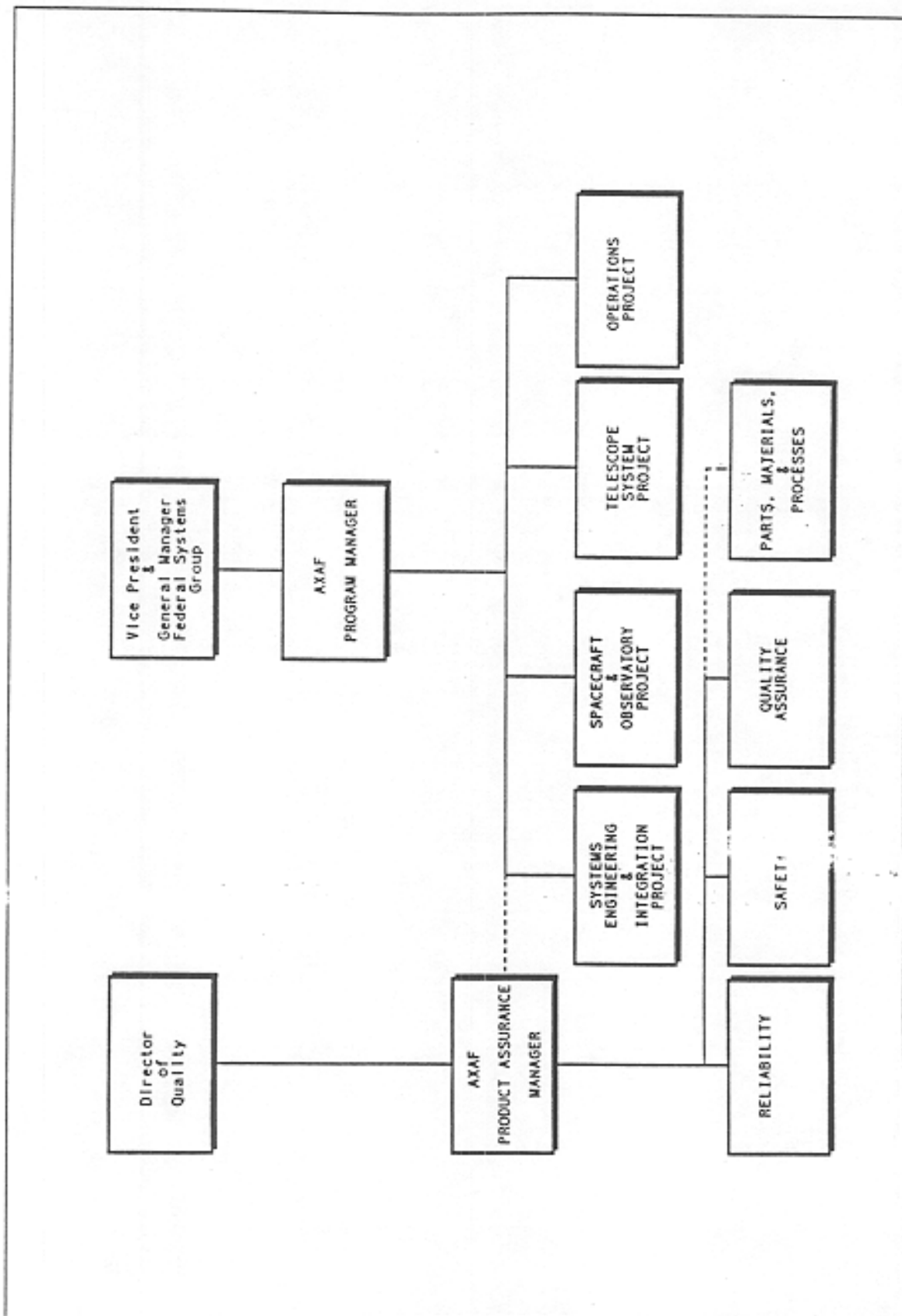


Figure 3-1. AXAF Program Organization

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The TRW Health and Safety (H&S) Skill Center provides industrial safety support to the AXAF program. H&S personnel monitor TRW facilities as part of an overhead TRW function. The H&S activity supporting AXAF is described in Appendix B (Industrial Safety/Occupational Health Program).

3.3 RESPONSIBILITIES

3.3.1 TRW

The ultimate responsibility for the conduct and overall implementation of the AXAF safety program rests with the program manager. He approves the safety plan and signs the certificate (letter) of safety compliance. Authority is delegated to the AXAF safety manager for safety program execution, with support provided by each AXAF functional element/technical discipline. The safety manager serves as the program's single point of contact for safety matters and chairs the AXAF Safety Working Group.

3.3.2 MSFC

The MSFC AXAF program office is the focal point for AXAF STS safety certification activities. TRW supplies supportive data to MSFC, prepares the safety compliance data packages, and presents them jointly with MSFC during phased safety reviews. TRW coordinates with other NASA agencies, e.g., Johnson Space Center (JSC), the Kennedy Space Center (KSC), and Goddard Space Flight Center (GSFC), as appropriate, during performance of AXAF safety activities.

3.4 INTERFACES

3.4.1 TRW

TRW System Safety will interface with all organizational elements of the AXAF Program including all subcontractors (e.g., Eastman Kodak Company (EKC), Hughes Danbury Optical Systems (HDOS), and approximately 30 others) and the suppliers of the science instruments to assure in-depth TRW penetration of all designs/operations and a highly-integrated safety effort. The safety program requires the performance of many interrelated tasks. System Safety manages, integrates, and directs the performance of these tasks to ensure an effective program. These tasks are described in Section 4 of this plan. Full use of the AXAF Safety working Group (ASWG) described in Paragraph 3.4.3 is made in accomplishing these tasks.

3.4.2 MSFC

The primary safety interface is with MSFC. System Safety assures MSFC is continuously informed of the progress of the safety program through weekly teleconference calls and quarterly Safety, Reliability, Maintainability, and Quality (SRM&QA) progress reviews. MSFC is also invited to participate in and supply

inputs to the ASWG. TRW and MSFC are jointly responsible for the success of the safety certification review process. TRW prepares the safety compliance data packages, and presents them jointly with MSFC to safety review authorities. TRW also provides other support necessary to provide appropriate safety communications between TRW and other concerned Government agencies.

3.4.3 AXAF Safety Working Group

A key management safety program control technique is the AXAF Safety Working Group. The ASWG meets periodically to assess program safety status and resolve safety issues. The ASWG has the management authority to assign action items, as needed, anywhere on the program. The ASWG also meets informally to address specific issues related to safety.

The ASWG is chaired by the safety manager. Its membership includes managers and responsible engineers from each program element/discipline (e.g., the systems engineering and integration project, the spacecraft and observatory project, the telescope systems project, etc.). Formal ASWG meetings are to (1) discuss identified risks/hazards and propose means of elimination or control, (2) provide a forum for technical interchange, (3) assess safety program status, (4) review, discuss, and critique hazard analyses, hazard reports, and other safety documentation, and (5) assign action items, as required (e.g., the performance of a specialized engineering analysis).

ASWG activities are informally documented by the safety manager and are reported to the program manager and the product assurance manager. Responses to action items or assignments are evaluated by the ASWG for completeness, degree of compliance to requirements, and degree of risk/hazard elimination or control.

3.5 RISK/HAZARD MANAGEMENT

The approach to risk/hazard management systematically defines and documents system safety requirements; identifies and documents potential risks and hazards to be controlled (either by design and/or by procedure); and controls each identified hazard until closure, providing objective evidence for traceability. The process utilizes the AXAF ASWG as a key element.

The risk/hazard management process is implemented under the direction of the AXAF safety manager. It is an iterative process consisting of three phases:

- o Requirements definition
- o Risk/hazard identification
- o Risk/hazard elimination, control, and closure

The process utilizes both AXAF requirements, experience and lessons learned from other TRW programs, and maximizes the use of



Figure 3-3. Risk/Hazard Management Process

technical expertise and experience available through the ASWG. The process is depicted in Figure 3-3. The results are documented in the Hazard Analysis (SA04) and the Risk Management Summary (SA05).

Hazards identified to date are presented in Figure 3-4. The risk/hazard management process continues through the duration of the program, thereby assuring the safety of the AXAF and the STS.

3.6 SAFETY CONTROL

The AXAF safety program relies on four primary control mechanisms:

- o A closed loop, iterative process of risk/hazard management and control
- o An AXAF Safety Working Group
- o Safety engineering approval of safety-related AXAF program documents
- o A rigorous safety certification process (phased safety reviews)

4.0 SAFETY TASKS

In managing and implementing the AXAF safety program, the AXAF safety manager is responsible for completion of both direct and supporting tasks. These tasks are identified in the task responsibility matrix of Figure 4-1.

4.1 CRITERIA DEVELOPMENT

System safety requirements are developed for the AXAF program by the safety manager and levied on design engineering through the AXAF system and equipment specifications which require AXAF product assurance approval prior to release.

The safety manager develops and/or defines safety requirements for but not limited to the following:

- o Cryogenics, pressurized equipment
- o Hazardous materials
- o Structural safety factors/stress corrosion
- o Electromagnetic emissions
- o Command and control functions
- o Thermal controls
- o Safety critical software

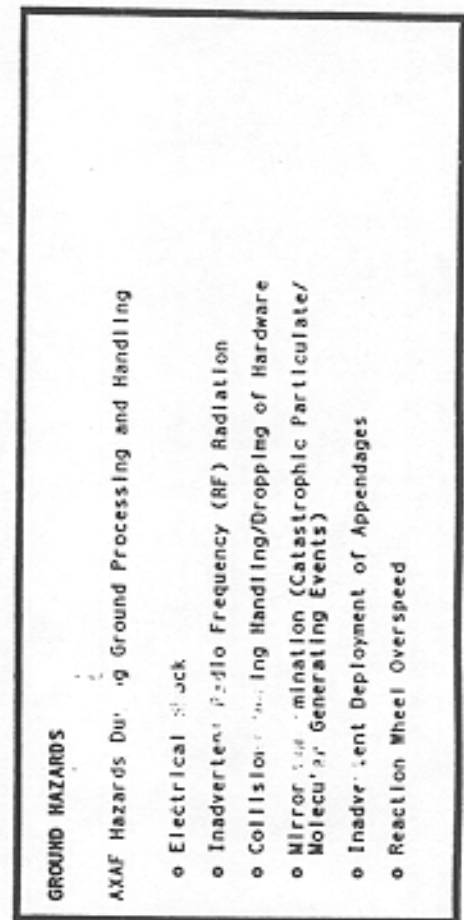
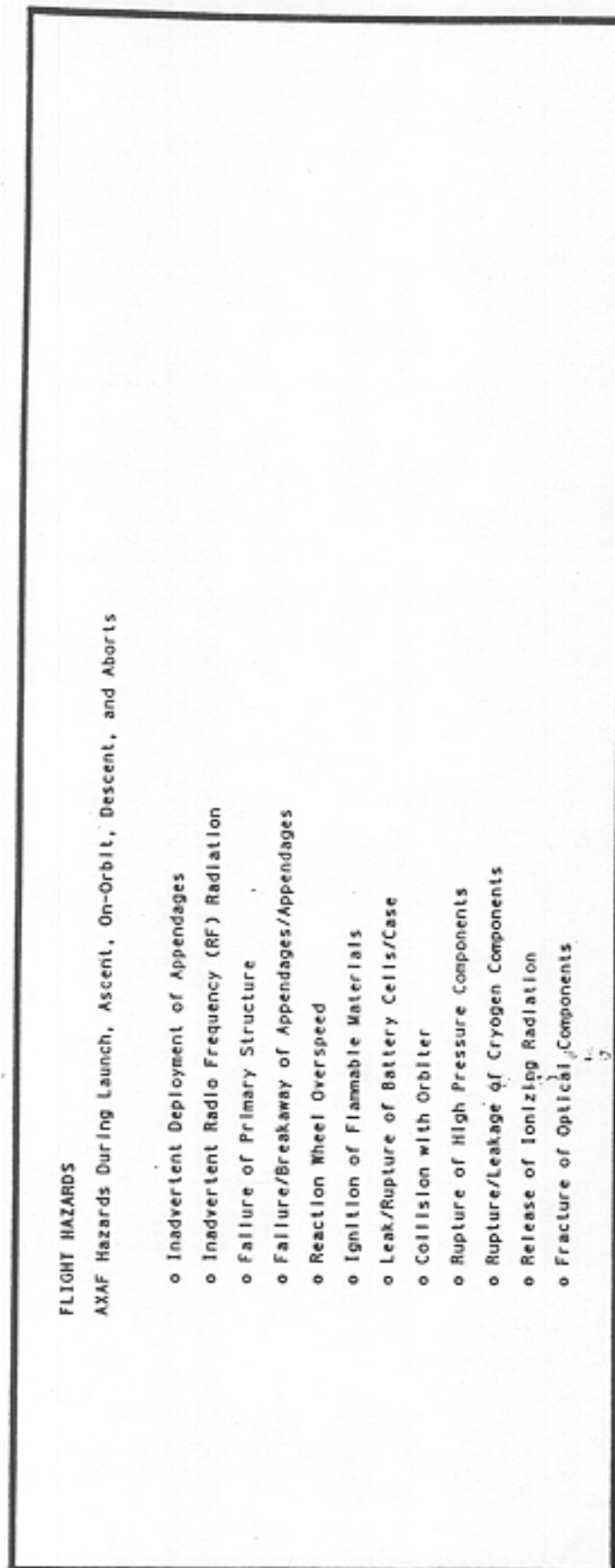


Figure 3-4. Identified AXAF Hazards

PROGRAM SAFETY TASKS	SYSTEMS ENG AND INTEG PROJ	SPACECRAFT AND OBSERV PROJ	TELESCOPE PROJ	OPERATIONS PROJ	RELIAB ENGR	SAFETY ENGR	SUB CONTRACTOR	PRODUCT ASSUR PROJ	PROG MGR
1. Criteria Development (4.1)	C	C	C	C	C	P/A	C	C	
2. Analyses (4.2)	S/C	S/C	S/C	S/C	S	P/A	A		
- Hazard Analyses								A	
- Support Analyses							P/S	A	
-- FMEA		S/C	S/C		P	C	P/S	A	
-- Sneak Circuit Analysis					P	C	S	A	
-- Limited Life Item List					P	C	S	A	
-- Critical Item List	A	P	P			C	P/S	A	
-- Fracture Mechanic Analysis	A	P	P			C	P/S	A	
-- Venting Analysis	A	P	P			C	P/S	A	
-- Stress Analysis	A	P	P			C	P/S	A	
-- Materials Usage Agreement							P/S	A	
3. Reviews (4.3)	S	S	S	S	S	P/A	S	S	S
4. Subcontractor Reqmts(4.4)	S	S	S		P/A	S	S		
5. Reporting (5.5)	C		C	C	C	P/A	P/S	A	A
- Risk Management Summary									
- Safety Compliance Data									
- Mishap Reporting									
- Safety Review Material									
6. Documentation File (4.6)	S	S	S	S	S	P	P/S		
7. Planning (4.7)	C					P/A	P/S	A	A
8. Evaluations (4.8)	S	S	S		S	P/A	S	S	
9. Safety Surveillance (4.9)	S	S	S			P/A	S	S	A
A = Approve C = Concur P = Preparation/Documentation Responsibility S = Support Responsibility									

Figure 4-1. AXAF Safety Program Responsibility Matrix

- o Handling of high value and program critical hardware
- o Electrical power
- o Ground support equipment and ground operations

The safety manager interprets NSTS 1700.7 safety requirements using the interpretations found in NSTS 18798/subsequent JSC correspondence, and experience gained on other programs.

4.2 ANALYSES

Hazard analyses are fundamental to the AXAF safety program and form the basis for all safety reports, reviews, and program deliverables. The following analyses will be performed and appropriately documented by safety and reliability specialists under the direction of the AXAF safety manager.

- o System Hazard Analysis (SA04)
- o Electrical Ground Support Equipment Hazard Analysis (SE38 input)
- o Mechanical Ground Support Equipment Hazard Analysis (SE39 input)

Hazard analyses are updated as the program progresses. Supporting analyses and details are maintained by program safety for future reference or backup, and are available for review by MSFC.

4.2.1 System Hazard Analysis

The System Hazard Analysis (SHA) covers AXAF manufacture, assembly and test, prelaunch/launch operations, in-bay checkout, deployment, and abort, including all program critical hardware handling operations. The approach and format is as described in Section 5.

4.2.2 Electrical Ground Support Equipment Hazard Analysis

The electrical ground support equipment (EGSE) hazard analysis covers manufacture, assembly and test, and prelaunch activities and concentrates on EGSE. It is performed in conjunction with the SHA.

4.2.3 Mechanical Ground Support Equipment Hazard Analysis

The mechanical ground support equipment (MGSE) hazard analysis covers manufacture, assembly and test, and prelaunch activities and concentrates on MGSE. It is performed in conjunction with the SHA.

4.2.4 Hazard Analysis Follow-up Action

Identified hazards are categorized per defined in NSTS 1700.7 and KHB 1700.7. Necessary steps are taken to assure that hazards are eliminated or properly controlled. Controls are selected based on the hazard reduction precedence sequence defined in NHB 5300.4 (1D-2), Section 1D201.6. Safety trade studies are performed, as necessary. Verification is through a closed-loop approach. Methods include inspections, analyses, tests, degree of hazard testing, margin of safety testing, and functional testing.

Hazards/controls relating to potentially significant risks to program critical hardware during AXAF manufacture, assembly and test, and prelaunch operations are subject to Operational Readiness Inspection (ORI) Committee review/approval.

4.3 DESIGN/PROGRAM REVIEW PARTICIPATION

4.3.1 Design Reviews

At Preliminary Design Review (PDR), Critical Design Review (CDR), and Configuration Inspection (CI), the program safety manager presents an assessment of AXAF safety status, including significant areas of concern with corrective actions or options, and a list of identified hazards, their hazard level per NSTS 1700.7 and KHB 1700.7, and the actions required to eliminate or control the hazards. This information is submitted to MSFC in the Risk Management Summary (SA05) (Section 4.5.1) prior to design reviews (Section 6).

4.3.2 Safety Reviews

JSC and KSC safety reviews are held approximately two to four weeks after system requirements review (SRR), PDR and CDR, respectively. This allows time to revise the safety compliance data to reflect the results of the design reviews. The JSC Phase III safety review is scheduled to occur after completion of the system level thermal vacuum test, while the KSC Phase III safety review is scheduled prior to CI and shipment of the AXAF to KSC. The JSC review is scheduled so that all JSC Phase III activities are completed more than 10 days prior to Flight Readiness Review (FRR). KSC Phase III activity is completed more than 10 days prior to the Ground Operations Review (Section 6). The data to be presented at the reviews is described in Section 4.5.4. TRW AXAF safety, with support from other AXAF program elements including subcontractors, assists MSFC at both JSC and KSC safety reviews.

4.4 CONTRACTOR/SUBCONTRACTOR REQUIREMENTS

4.4.1 Subcontractors

TRW levies safety requirements on subcontractors through equipment specifications, statements of work, and Product Assurance Requirements (PAR) documents. These documents specify

the safety design, analysis, programmatic, and data reporting requirements necessary for TRW to maintain adequate management control and integrate subcontractor activities and data into the overall AXAF safety effort. The safety manager provides inputs to these documents and monitors subcontract performance. He conducts safety audits to assure that required safety analyses are performed acceptably and that safety data are available to meet overall AXAF safety program needs. Technical interchange meetings are scheduled periodically with subcontractors to ensure the adequacy of the subcontracted safety effort. Subcontractors support safety reviews, as required.

4.4.2 Science Instruments

TRW levies interface requirements on instrument principal investigator's (IPIs) through formal interface control documents (ICDs). Technical interchange meetings are scheduled with each IPI on an as-needed basis to penetrate the design of the science instruments, critique the SI safety effort, and to ensure safety analyses and other data provided by the IPIs can be integrated into the overall AXAF safety effort. IPIs are expected to participate in meetings of the AXAF Safety Working Group.

4.5 REPORTING

4.5.1 Risk Management Summary

The Risk Management Summary (SA05) is prepared by the AXAF safety manager using the data and analyses developed during the risk/hazard management process (Section 3.5). The risk management summary summarizes AXAF's risk management activities as they relate to safety and is used for management overview/decision making purposes. Included is a hazard summary providing a listing of identified risks and hazards, the source of the identification (analysis, test, etc.), the hazard level, and the status of the hazard controls. Residual hazards and rationale for acceptance are also included. An assessment of safety program activities (e.g., ORIs, training, movement of program critical hardware, accident information, etc.) are provided. Residual catastrophic and critical hazards are reported promptly to MSFC. The risk management summary is submitted to MSFC at least three weeks prior to PDR, CDR, and CI.

4.5.2 Hazard Analyses

The system hazard analysis (SA04), electrical ground support equipment hazard analysis (input to SE38), and the mechanical ground support equipment hazard analysis (input to SE39) are prepared and submitted as described in Sections 4.2 and 5.

4.5.3 Safety Compliance Data

Preparation of safety compliance data (SA01) necessary for AXAF safety certification involves developing, collecting, and documenting the program data shown in Figure 4-2. Engineering

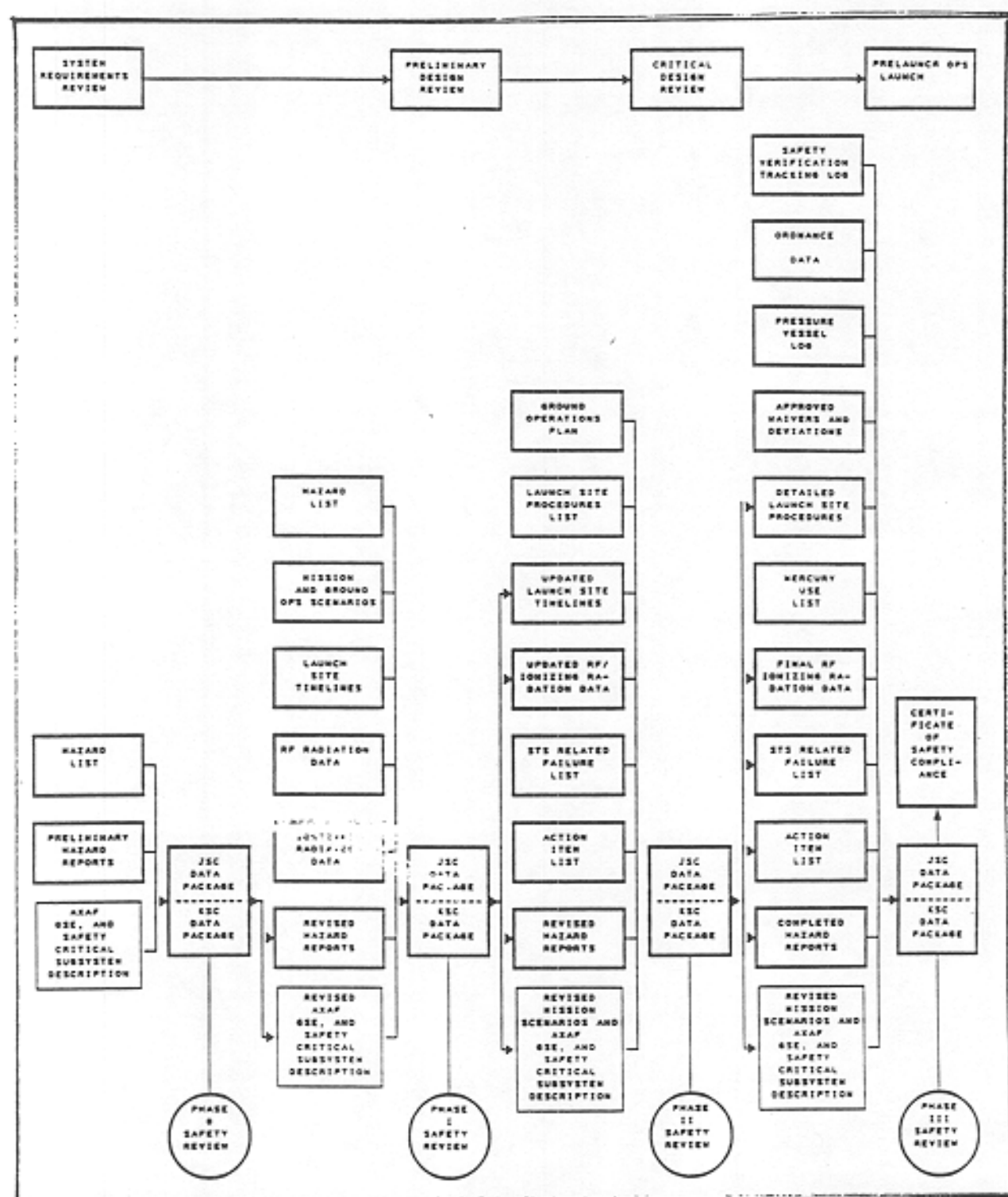


Figure 4-2. Safety Certification Process

assessments are performed to verify that AXAF complies with the safety requirements in NSTS 1700.7 and KHB 1700.7.

4.5.3.1 Safety Compliance Data Package

STS safety compliance data packages are prepared and maintained in accordance with NSTS 13830 to provide evidence of compliance with NSTS 1700.7 and KHB 1700.7 safety requirements and to document in hazard report form the results of the hazard analyses. Minor radioactive sources are documented per the requirements of NSTS 13830 and MMI 1860.4. The safety compliance data packages comprise the review material for the Phase I, I, II, and III flight and ground safety reviews.

4.5.3.2 Safety Compliance Data Processing

Safety compliance data are submitted to MSFC at least eight weeks prior to scheduled phased safety reviews as required by SA01. After MSFC approval, the safety compliance data packages are forwarded by MSFC to JSC and KSC. JSC and KSC establish the official safety review dates after reviewing the safety compliance data packages.

Changes to AXAF/GSE design/operations made subsequent to the Phase III flight and ground safety reviews are assessed for possible safety implications. The assessment is forwarded to MSFC and either the JSC or the KSC safety panel, as appropriate, for review and approval. The assessment includes the reason for the change and the safety impact, if any. New or revised hazard reports and support data are prepared, where applicable, and submitted for approval.

At the Flight Readiness Review (FRR), a flight readiness statement is presented based on the final safety status (including post Phase III activity) of the AXAF. The AXAF program manager certifies at the FRR that all hazards have been identified, assessed, and eliminated or controlled. Open safety items at the time of the FRR are addressed at the "L minus 2" briefing prior to launch.

4.5.3.3 Safety Verification

The safety verification effort begins when the Phase II hazard reports are approved (during or shortly after the Phase II flight and ground safety reviews). Each hazard report contains a safety verification section which specifies in detail how implementation of each hazard control is to be verified (usually, by inspection, analysis, demonstration, or test). Safety verifications are completed prior to Phase III if feasible, or are recorded on safety verification tracking logs for subsequent tracking/closeout. Final safety certification is contingent on closeout of all safety verifications.

4.5.4 Safety Review Documentation

Safety compliance data (SA01) to be presented at the JSC and KSC safety reviews comply with the requirements of NSTS 13830. Briefing data are provided to MSFC, and to JSC or KSC, as applicable, per the schedule in Section 6 on the following topics (the topics vary for each review phase):

- o Status of previous review activities/action items
- o Overview of the AXAF and any associated airborne support equipment (ASE); overview of the mission including AXAF in-bay checkout and deployment on the remote manipulator system (RMS); overview of GSE, ground processing concept, and milestone schedules
- o Descriptions of safety-critical subsystems
- o Applicable safety requirements
- o Hazard reports
- o Mission scenario
- o AXAF/GSE design and operations changes since last review
- o Accident/incident/mishap data
- o Noncompliance reports

4.5.5 Accident/Incident/Mishap Reporting

TRW investigates and reports accidents, incidents, mishaps, and close calls in accordance with SA02. Reporting encompasses manufacturing, assembly, test and launch operations. The results of these investigations are used to formulate and implement corrective actions to preclude recurrence in future operations. STS related events are included in the safety compliance data packages. TRW safety provides technical assistance to NASA boards investigating mishaps which occur within their jurisdiction. All investigation reports are kept on file for review by MSFC.

4.5.6 Deviations and Waivers

Requests for deviation to system specifications, test procedures, and drawings are prepared by the office proposing the deviation and are reviewed by the safety manager. Configuration Management (CM) is the focal point for all AXAF-generated deviations and waivers. Upon acceptance and approval, the request is proposed to MSFC by formal submission of an engineering change proposal. all safety-related deviation requests and their disposition are included in the safety data compliance packages.

4.6 SAFETY DATA

TRW maintains safety data files related to the AXAF. Data maintained include the following:

- o AXAF Safety Working Group (ASWG) minutes (informal)
- o Hazard analyses, including input data, such as FMEAs, sneak circuit analyses, fracture mechanics analyses
- o Safety compliance data
- o Risk management summaries
- o Safety Action Requests (SARs)
- o Action items and responses
- o Requests for waiver, and responses
- o Accident/incident/mishap files
- o Safety data provided by NASA, subcontractor, suppliers, and instrument principal investigators (science instruments)

4.7 PLANNING

Planning is a key element of the AXAF safety program. The following sections describe the two plans which form the basis for the total AXAF safety program.

4.7.1 AXAF Safety Plan

The AXAF Safety Plan integrates the safety activities of TRW, TRW subcontractors, and suppliers into a single, cohesive safety program. It forms the basis for management, control, and implementation of the AXAF safety program. This plan is supplemented by additional safety planning (Sections 4.7.2 and 4.7.3) which is developed during the assembly and test phases of the program.

4.7.2 Launch Preparation and Launch Operations

TRW prepares an AXAF Launch Site Safety Plan per KHB 1700.7. This plan addresses safety awareness and other safety training of TRW AXAF launch personnel. The AXAF launch site safety plan implements lessons learned from previous TRW launch site planning activities and encompasses the following:

- o Launch site payload organization
- o Personnel procedures for training, physical examinations, certification, safety enforcement, and extended hours

- o Control of hazards during ground operations and GSE certification (including MSFC-STD-126E)
- o Procedure review
- o Support to launch site safety operations
- o Emergencies and aborts

The launch site safety plan is delivered to MSFC and KSC at least 30 days prior to shipment of AXAF to KSC.

4.8 EVALUATIONS

The AXAF safety manager periodically audits AXAF program safety activities and subcontractors per the schedule in Section 6.

In addition, independent S&TG Quality audit personnel review various TRW projects and functional organizations on a scheduled basis, per S&TG Policy and Procedure Manual, Section S-102. Results of these audits are reported to the AXAF safety manager, functional area managers, and are presented to formal TRW Corrective Action Boards (CABs), where corrective actions are assigned and progress toward closure is monitored.

TRW supports Government audit teams periodically auditing AXAF safety activities. Files of AXAF audits are maintained for review by MSFC and other Government representatives on request.

4.9 SAFETY SURVEILLANCE OF HAZARDOUS OPERATIONS

4.9.1 Manufacturing, Assembly and Test

System Safety is responsible for monitoring the manufacturing, assembly, and test phases of the AXAF Program to ensure that activities which could adversely affect the safety of AXAF hardware or cause personnel injury are adequately safeguarded.

System Safety reviews and approves hazardous test procedures, special test procedures, and changes thereto. Hazardous procedures are defined by Assembly and Test Operation (ATO) Special Practice 3-5 to include procedures involving: (1) handling/transportation of spacecraft/major components, (2) pressurization/fueling, (3) ordnance handling/installation, (4) ionizing/non-ionizing radiation, and 5) cryogenics. Such procedures are prominently stamped "hazardous". System Safety also reviews and approves test plans for AXAF-unique facilities and test equipment where AXAF hardware may be at risk, and reviews changes to test equipment to ensure safety. A log is maintained to record all actions taken with respect to approval/critique of procedures, plans, and other documents.

System Safety monitors hazardous tests/operations, including handling of program critical hardware, as deemed necessary to ensure adherence to safety principles and compliance with the

safety requirements identified in the hazard analyses. Where the risk is deemed acceptable, specially trained quality assurance personnel may provide such surveillance on a case by case basis. System Safety also actively participates in operational readiness inspections (ORIs).

4.9.1.1 Operational Readiness Inspections

ORIs are planned and scheduled in accordance with MMI 1700.6. they include a safety evaluation of facilities, equipment, test articles, operational procedures and personnel capability.

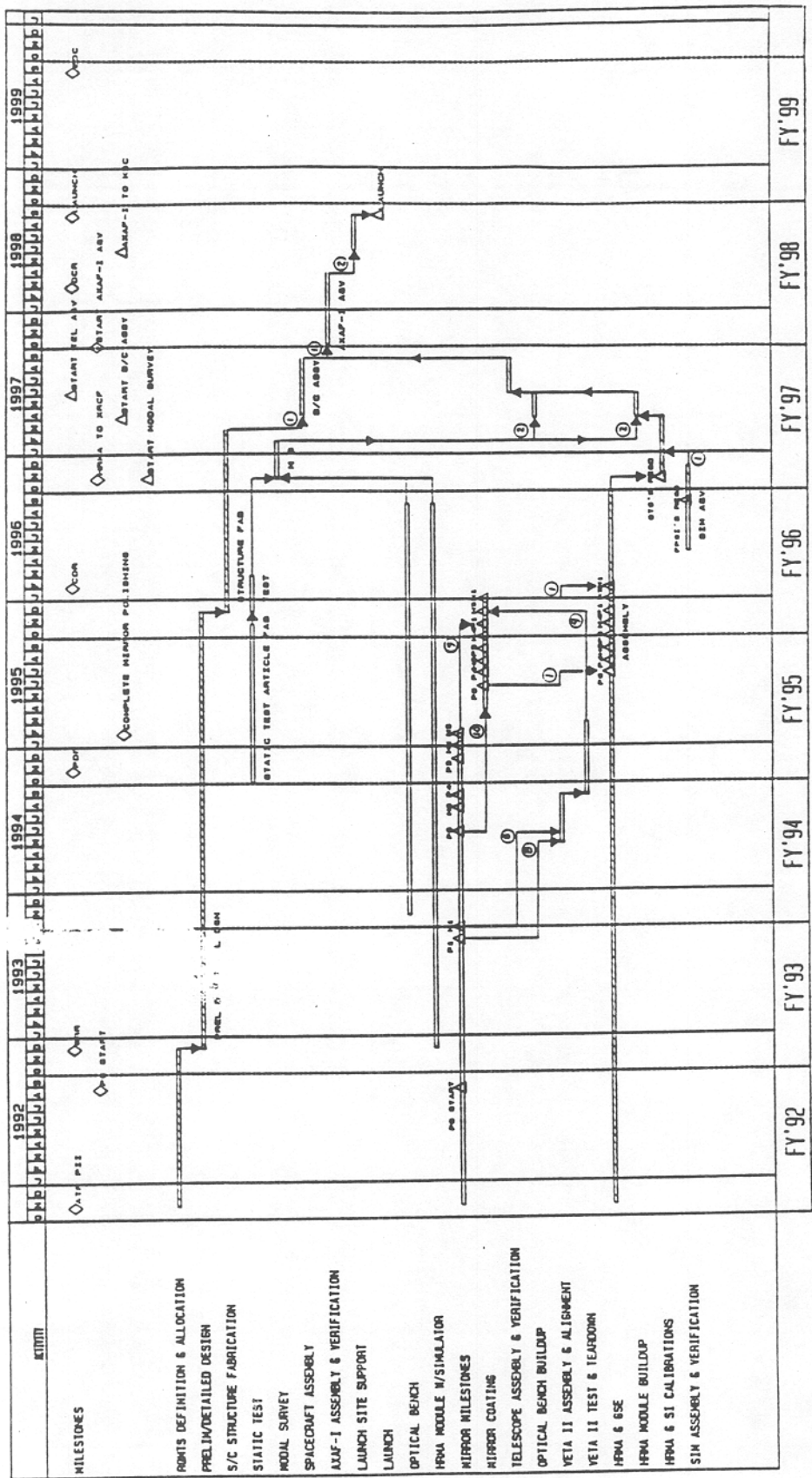


Figure 4-3. AXAF Program Critical Path

Figure 4-3 graphically depicts the AXAF program critical path. The mirror elements are on the critical path for the entire duration of the AXAF program -- coincidentally, the mirror elements are categorized as program critical hardware because of the value added during polishing and coating. ORIs will therefore be scheduled around events on the critical path in Figure 4-3 as follows:

- o Mirror end cutting (HDOS)
- o Mirror handling, polishing, coating, and transportation (HDOS)
- o VETA-II assembly, alignment, test, and tear down (Kodak)
- o HRMA assembly (Kodak)
- o HRMA/science instrument calibration (Kodak)
- o HRMA module buildup (Kodak)
- o Telescope assembly/test (Kodak)
- o Telescope transportation (Kodak)
- o AXAF assembly and test (TRW)
- o Launch site support (TRW)

The ORIs will be patterned after the successful ORIs held during Phase I of the AXAF program, with two MSFC personnel serving on the ORI committee. A representative ORI agenda is shown in Appendix A. The specific agenda topics vary for each ORI.

4.9.1.2 Program Critical Hardware

As described in Section 4.9.1.1, program critical hardware activities occur throughout the AXAF program from receipt of mirror blanks at HDOS through launch at KSC. Program critical hardware handling is performed in accordance with MMI 6400.2.

The TRW Packaging, Handling, and Transportability Engineering Manual provides protection standards from the start of design through delivery. Shipping container designs comply with NHB 6000.1 and other requirements, using TRW, industry, and Government standards as guidelines. The NASA critical item label is attached to the outer packaging containers of equipment designated program critical. TRW Assembly and Test Operations Procedures 2-3, 3-5, and 3-18 specifically address handling of program critical hardware in the vehicle assembly and test area.

4.9.1.3 Personnel Training and Certification

Personnel are properly trained and certified for performance of hazardous testing and operations prior to start of these

activities. TRW's ongoing training and certification program meets the intent of MMI 1710.6.

4.9.2 Preflight Operations

The AXAF program safety engineer responsible for launch site operations conducts activities in accordance with the launch site safety plan (Section 4.7.2).

5.0 METHODS FOR ACCOMPLISHING SAFETY TASKS

Methods for developing safety criteria, performing analyses, and assuring protection of program-critical hardware and personnel are described below:

5.1 SAFETY CRITERIA

The development of AXAF safety design, test, and operational criteria is an ongoing, iterative process. The majority of the AXAF safety criteria are derived from the applicable documents listed in Section 2, supplemented by hazard controls defined during the hazard analyses process (Section 5.2).

Safety criteria are developed for:

- o Protecting program-critical hardware, and handling/lifting equipment
- o Special test equipment (STE) such as VETA-I
- o Launch site ground operations
- o Protection of the STS, AXAF, other STS payloads, and personnel associated with AXAF

The AXAF safety criteria are disseminated throughout the project by program directives; design, procurement and test specifications; and training/safety criteria documents.

5.2 ANALYSIS TECHNIQUE

The closed-loop system of hazard identification, control, and compliance verification (Figure 3-3) is key to completion of the AXAF safety certification. The steps in this process are:

- o Compile a listing of generic hazards and undesired events (e.g., unintentional RF radiation) based on lessons learned from other programs and inputs from the ASWG and other sources
- o Perform an energy source evaluation -- i.e., identify sources of energy, magnitude, and their damage-producing potential
- o Using the generic hazard/undesired events listing and the energy source evaluation above as references, systematically identify and evaluate potentially hazardous conditions/events

by mission phase and by system/component (operational threat analysis) using the disciplined approach provided through use of hazard analysis worksheets

- o Finally, for conditions/events determined to be hazards:
 - Allocate requirements for hazard controls to subsystems
 - Prepare hazard reports
 - Submit hazard analysis/reports to the ASWG for review and concurrence

5.2.1 Undesired Events

Conditions of undetermined hazard/cause potential are classified as undesired events. A condition is only classified as a hazard/cause, if there is objective evidence that this is the case. If objective evidence cannot be obtained, then the undesired event is considered not to have hazard/cause potential.

Undesired events can be hazards, causes of hazards, or neither. For example, two typical undesired events that may be a hazard under certain conditions are:

- o The premature operation of a spacecraft reaction wheel when the spacecraft is being launched by the Orbiter
- o Inadvertent deployment of a solar array when the spacecraft is in the Orbiter payload bay.

In both cases, analyses will be performed to determine the energy potential of the postulated events and to determine the damage/loss sensitivity of the STS Orbiter.

The initial list of generic hazards/undesired events is derived from NASA and DoD lessons learned, such as those found in NSTS 18792. Additional generic hazards/undesired events identified by the ASWG, MSFC, or other entities are evaluated for addition to the list.

5.2.2 Energy Source Evaluation

The energy source evaluation is the main analysis tool used to review AXAF design and operations for sources of hazards/causes. This analysis holds two promises: 1) most hazards emanate from energy sources, and 2) uncontrolled energy is an essential element in most, if not all, accidents and incidents.

Each subsystem and component is evaluated for sources of energy (Figure 5-1). Once the energy sources are determined, an assessment is made as to the consequences of premature or unintentional energy release. This phase of the analysis provides a systematic method for ensuring that sources of hazards and accidents/incidents are identified.

5.2.3 Hazard Analysis

The listing of generic hazards/undesired events and the results of the energy source evaluation are used as part of the hazard analysis. The generic hazards/undesired events and other potentially hazardous conditions are then evaluated for hazard effect/severity level for each subsystem/component and for each mission phase (Figure 5-1). Undesired events which are determined to have threat potential are reclassified as a hazard and a hazard/severity level is established.

At this point, undesired events are evaluated and classified as a hazard, where applicable. Undesired events not classified as a hazard are closed at this point, and no further analysis of the event is performed.

5.2.4 Subsystem Hazard Control Allocation

Safety requirements for identified hazards are allocated to AXAF subsystems. This information is needed to complete the STS payload safety requirements applicability matrix (Figure 5-2) and provides the basis for determining the appropriate hazard/causes addressed in the hazard reports.

5.2.5 Safety Requirement Matrix

As the STS hazards and their causes are identified, the STS payload safety requirements applicability matrix in NSTS 13830 (Figure 5-2) is completed for the flight portion of the SHA. This matrix is initially completed to the component level; however, for the safety compliance data, the information on the matrix is documented at the AXAF subsystem level. Also, a similar matrix addressing KHB 1700.7 requirements is developed for launch site operations.

An "X" is placed in the row in the matrix (Figure 5-2) for the subsystem/component having primary hazard control. A slash ("/") is placed in the row for the subsystem/component having secondary hazard control and where no hazard is identified. If a noncompliance is identified, the applicable block on the matrix is marked as indicated in Figure 5-2. After the matrix is completed, the STS hazards being controlled by each block marked with an "X" are listed on Form 1090A in NSTS 13830.

5.2.6 Hazard Reports

Hazard reports are the primary documents used to ensure (1) that hazards are identified, (2) that the hazards are controlled to an acceptable level, and (3) that implementation of the controls is verified, using JSC Form 542B as specified in NSTS 13830 and the phased safety review process. AXAF's design and operational procedures are evaluated to ensure compliance with the safety requirements specified for control of each hazard as identified in the safety requirements applicability matrix. When procedures are designated as hazard controls, the procedural step(s) are

AXAF HAZARD ANALYSIS (SAMPLE)

PROJECT: AXAF		MISSION PHASE:		SYSTEM:		POTENTIAL MISHAP		HAZ LEV	HAZ RPT
SUBSYSTEM	COMPONENT	ENERGY SOURCE	ENERGY RELEASE MECHANISM						
PCAD (Pointing Control and Aspect Determination)	RWA (Reaction Wheel Assembly)	Potential	Structural Failure			RWA attachment falls under launch or landing loads	CAT	Fxx	
		Electrical	Her			Ignition of flammable materials used in RWA, fire propagation to Orbiter	CAT	Fxy	
		Electrical	Arc			Ignition of flammable materials used in RWA or of flammable atmospheres present during Orbiter abort/descent; fire propagates to Orbiter	CAT	Fxz	

Figure 5-1. Hazard Analysis Worksheet

itemized in the hazard report. In addition, other analyses (e.g., flammable material analyses, stress corrosion analyses), drawings, procedures, material review data, test results/failures, and accidents/incidents/mishaps are reviewed to ensure that as-built hardware complies with the requirements. Design and procedure changes are reviewed before and after the Phase III safety review to ensure the accuracy and adequacy of the hazard reports. If any safety critical changes occur after the Phase III review, the changes are sent to MSFC, and then subsequently to JSC and KSC. If non-compliances are identified, a noncompliance report is prepared and referenced in the hazard report.

5.2.7 AXAF Safety Working Group

The results of the activities above are reviewed by the ASWG (Section 3.4.3) for concurrence. If additional analyses are required, the ASWG initiates a Safety Action Request (Figure 5-3) to develop necessary information for the hazard analysis. A tracking system for formal Safety Action Requests (SARs) will be maintained on SprintMail and issued weekly to all relevant personnel.

5.3 OTHER PROGRAM ACTIVITIES

During the assembly and test and launch site operation phases of the program, the safety of personnel and equipment is controlled by the following safety critical S&TG Advanced Systems Development Division, Assembly and Test Operations, General Standard Practices:

- o SP 2-0 General Safety Practices
- o SP 2-1 General Personnel Safety Practices
- o SP 2-2 Safety-Area Managers Committee
- o SP 2-3 Material Handling and Lifting
- o SP 2-13 Safety Action Request (SAR) Procedure
- o SP 3-5 System-Level Assembly and Test Procedures
- o SP 3-9 Special Task Procedure (STPs)
- o SP 3-11 Reporting and Analysis of Unplanned Events, Incidents and Alerts
- o SP 3-16 Personnel Training

6.0 SCHEDULE FOR TASK COMPLETION

Schedules for each task (Section 4), deliverable documents, safety reviews, and their relationship to AXAF program master milestones, are shown in Figure 6-1. The milestone schedule also

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shows AXAF safety engineering manpower levels expressed in number of persons per month and phased to the program activities. Significant contributions to the safety effort are also made by the AXAF Safety Working Group and supporting personnel, and the TRW overhead-funded Health and Safety organization.

SAFETY ACTION REQUEST

1 Project/Area		2 Expedite _____ SAFTAR No. _____ Routine _____ Date Issued _____ Response Date _____ Originator _____ MS _____ Ext _____		
3 To: _____ Ms _____ Ext _____				
4 Description of Hazardous Condition/Event/Item				
5 Requested Action and Rationale				
6 Corrective Action to be Taken				
Action Assigned to _____ MS _____ Ext _____ Completion Date _____ Mfg Signature _____ SSC Signature _____				
7 Follow Up				
Date	To	From	Current Disposition/ Further Action Required	Initial
8 Distribution:				
Close Out Date: _____ PHR No. _____				

Figure 5-3. Safety Action Request Form

	CY 92				CY 93				CY 94				CY 95				CY 96				CY 97				CY 98				CY 99											
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q												
PROGRAM MILESTONES	SRR				PI/HI End Cut				PDR Production Mirror Grind, Polish, Coat				CDR				HRMA A&T				Spacecraft A&T				Telescope A&T				AXAF A&T				FRR				A Launch			
Safety Reviews	PH				PH				PH				PH				PH				PH				PH				PH				PH				PH			
Safety Tasks:																																								
1. Criteria Development	V																																							
2. Analyses																																								
3. Reviews																																								
4. Subcontractor Requirements																																								
5. Reporting																																								
6. Documentation																																								
7. Planning																																								
8. Evaluations																																								
9. Safety Surveillance																																								
10. Operational Readiness Inspections																																								
DELIVERABLES:	Draft																																							
1. Safety Plan SA-03																																								
2. Hazard Analyses SA-04																																								
3. Safety Compliance Data SA-01																																								
4. Risk Management Summary SA-05																																								
5. Mishap Report SA-02																																								

Figure 6-1. AXAF Safety Milestones

APPENDIX A
TYPICAL ORI AGENDA

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Typical ORI Agenda

- o Manufacturing Process Overview
 - Receive presentation on the manufacturing operation(s) to be appraised -- presenter should use visual aids showing equipment and planned operations
 - Quality assurance statement that all open issues have been resolved
- o Safety Requirements/Criteria
 - Receive presentation on the safety requirements/criteria applicable to the manufacturing operation and the results of hazard analyses performed
 - Assess adequacy of the controls implemented for each hazard
 - Validate that all safety verifications have been satisfactorily closed
- o Equipment Design/Safety Compliance
 - Receive presentation describing the design of the grinding/polishing/metrology station (including software descriptions/flows) and the design of the lifting/hoisting/support equipment
 - Assess compliance with applicable safety criteria and hazard controls
 - Assess compliance with MSFC-STD-126E lifting/hoisting/support equipment design safety factors (i.e., rated load, design yield, design ultimate)
 - Identify areas requiring additional hazard analyses/controls
- o Equipment Design Conformance -- Inspection Records
 - Assess station (including software) and lifting/hoisting/support equipment compliance with safety-approved specifications/drawings, based on inspection/validation records
 - Verify incorporation of safety-approved engineering change notices in hardware/software
- o Proof Load Test Status
 - Identify all equipment which will lift or carry loads during the operations covered by the ORI

Typical ORI Agenda (Continued)

- Verify all such equipment is load test certified to the correct values, and within the expiration date of such certification
- Cover project unique equipment as well as facility items
- o Dry-Run/Demonstration Results
 - Receive presentation on the dry-runs/demonstrations which have been conducted with emphasis on events having safety significance
 - Identify the revision level of procedures which governed the dry-runs/demonstrations and relate them to those to be used for conduct of the operation
 - Ensure implementation of any corrective actions/lessons learned
 - Determine whether additional rehearsals/demonstrations/corrective actions are required
- o Operating Procedures
 - Evaluate operating procedures to verify the following:
 - o Safety and other required approval signatures are evident
 - o Real time safety surveillance is specified, where appropriate
 - o Certified operators are specified/identified, as appropriate
 - o Hazard controls (caveats, warnings, MIPs) are addressed
 - o Equipment calibration and proof load requirements are identified and space is provided to verify currency
 - o Required tools and equipment are identified (e.g., protective clothing, tethers)
 - o Satisfactory ORI completion is specified as a prerequisite for initiating operations
- o Personnel Requirements
 - Review the types of certified operators which will be needed
 - Review the training provided to achieve certification
 - Review operator training/certification records
 - Verify trained/certified personnel are available to support operations for each shift, as appropriate
 - Ensure backup personnel have been identified and are properly trained

Typical ORI Agenda (Continued)

- Establish shift change policies if required
- o Facilities Status
 - Establish that all facilities and utilities are available to support the operation including:
 - o Prime electrical power
 - o Emergency electrical power
 - o Uninterruptable power supplies
 - o Safety equipment (e.g., fire extinguishers, goggles, eye wash)
 - o Barricades/warning signs
 - o Ventilation, heating, and air conditioning
 - o Lighting
 - o Cranes (proof load testing current)
- o Industrial Safety Compliance
 - Ensure industrial hazards are identified and warnings/barriers are provided, as appropriate
 - Verify conformance with controls cited in Material Safety Data Sheets for chemicals/other substances used
 - Verify conformance with other occupational safety codes
- o Walkdown Inspection
 - Conduct team visual examination of station, lifting/hoisting equipment, facilities, etc.
 - Ensure safety critical controls are clearly labeled
 - Ensure warning signs are displayed, as appropriate
 - Ensure personnel are protected from moving parts
 - Ensure cables and power cords are routed to avoid personnel injury
- o Wrap Up and Action Item Assignments

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APPENDIX B
INDUSTRIAL SAFETY/OCCUPATIONAL
HEALTH PLAN

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1.0 INTRODUCTION

Industrial safety and health support for the AXAF Program is provided through the established Health and Safety Skill Center (Support Services Organization, Electronic Systems Group, TRW Space and Defense Sector). Through this existing program for occupational safety and health, regular surveillance is maintained over AXAF work areas to ascertain hazards and ensure compliance with applicable federal, state, and local safety and health regulations. Particular emphasis is placed on work areas which involve fabrication, assembly, and test operations. Procedures that involve movement or test of program critical hardware (per MMI 6400.2) are reviewed by AXAF System Safety and are subject to the ORI process. The design and utilization of access equipment and work stands which require personnel to work at hazardous heights meet OSHA standards. Figure A-1 illustrates compliance with applicable health and safety requirements.

In addition to the requirements of NHB 5300.4 (1D-2), TRW's Common Use Management System Health and Safety Manual provides guidance in the areas listed in Figure A-2.

2.0 TRW OCCUPATIONAL SAFETY AND HEALTH PROGRAM

The Occupational Safety and Health Program at TRW Space and Defense is described in Attachment I of this plan. Implementation of the program is the responsibility of the Health and Safety Skill Center which is organized to provide functional support in the areas of occupational safety, environmental health, health services, fire protection, emergency planning and training, and radiation safety for all company employees and facilities.

The Health and Safety Skill Center assigns a representative to each of the Groups within TRW Space and Defense Section. The group representative is responsible for providing health and Safety support to the group including the utilization of all required professional resources, for example, fire protection and environmental health.

3.0 APPLICABLE CODES AND REGULATIONS

The primary objective of the TRW Health and Safety policy is to maintain a safe working environment. Part of achieving that objective involves compliance with legally required safety and health codes and regulations. Such codes and regulations applicable to TRW Space and Defense operations in Southern California include the following:

NHB 5300.4 (1D-2)		COMMON USE MANAGEMENT SYSTEM
SUBJECT	SECTION	
Committees	1D202-1	1.1, 1.2, 1.3, 1.5
Training	1D202-2	1.11, 2.11, 3.9
Certification	1D202-3	1.11, 2.13, 2.14, 2.15, 4.4
Motiviation	1D202-4	1.11, 2.11, 3.9
Inspections and Audits	1D202-5	1.7, 1.8, 1.10
Control of Unsafe Conditions	1D202-6	1.7, 1.8, 1.10, 2.17, 3.3 3.6, 3.8, 7.1, 7.2, 7.3, 7.4
Design, Construction, and Activation of Facilities	1D202-7	2.8
Operation and Maintenance of Facilities	1D202-8	2.3, 2.8, 3.6, 6.2
Fire Prevention and Protection	1D202-9	5.1, 5.3, 5.4, 5.5, 5.6, 5.7
Handling and Storage of Hazardous Materials	1D202-10	2.7, 3.2, 3.9, 5.5
Transportation	1D202-11	1.6, 2.13, 2.14, 3.2
Hazards to Public	1D202-12	2.1, 2.2, 2.7, 2.17, 3.0, 5.5, 6.0, 7.0
Accident Investigation and Reporting	1D202-13	1.7, 2.5, 7.2
Hazardous Operations	1D202-14	2.17, 3.1, 3.2, 3.8, 3.9
Personnel Protective Equipment	1D202-15	1.10, 2.3, 2.11, 2.12, 2.16, 3.5
Contingencies, Emergencies, and Disasters	1D202-16	6.2, 6.4, 7.2
Subcontractor Industrial Safety	1D202-17	Policy Under Development

Figure A-1. AXAF Health and Safety Compliance Matrix

SUBJECT	COMMON USE MANAGEMENT SYSTEM
HAZARD COMMUNICATION	1.2, 1.3, 1.7
RESPIRATORY PROTECTION	2.11, 3.5, 3.6
HEARING CONSERVATION	2.11
MEDICAL SCREENING AND SURVEILLANCE	4.1, 4.4
POLLUTION CONTROL	3.2
INDUSTRIAL HYGIENE	3.1, 3.2, 3.9, 4.1, 4.4

Figure A-2. Health Requirements

3.1 California Occupational Safety and Health Act (CAL/OSHA)

The primary safety and health standards for California business and industry.

3.2 Federal Occupational Safety and Health Act (OSHA)

Applicable to California business and industry where requirements of CAL/OSHA are silent or not as stringent as OSHA requirements; also applicable to other states.

3.3 Fire and Safety Requirements of Local Communities Such as the Cities of Redondo Beach, Manhattan Beach, and El Segundo, California

Uniform Fire Code, published by Western Fire Chiefs Association; Uniform Building Code.

3.4 Los Angeles County Electrical Code

4.0 SAFETY INSPECTIONS AND SURVEYS

Functional supervisors maintain the health and safety aspects of their work areas. Evaluation of work environments and conditions in relation to both legally required safety standards and TRW Health and Safety policies and practices is accomplished by the Health and Safety Skill Center. Work areas are inspected periodically by the Health and Safety Skill Center and the findings are reported to supervisors for corrective action.

5.0 ACCIDENT/INCIDENT INVESTIGATIONS AND REPORT

5.1 EXISTING PROCEDURES

Accidents and significant fire and safety incidents at TRW Space and Defense are investigated by the Health and Safety Skill Center and cognizant management. Investigation and reporting include Worker's Compensation information as well as accident/injury data, supervisor reports and, depending on the nature of the accident/incident, a full report by the Health and Safety Skill Center. Accident investigation and reporting is an established procedure in TRW's Occupational Safety and Health Program.

5.2 REPORTING OF FATALITIES ARE SERIOUS INJURIES

CAL/OSHA (State Safety and Health Law) required TRW to promptly notify the California State Division of Occupational Safety and Health when fatalities or serious injuries occur. Reporting procedures have been established to meet this requirement. TRW will promptly report to MSFC, via the AXAF safety manager, any accident associated with the AXAF program resulting in fatality, disabling injury, or disease.

6.0 SUBCONTRACTOR SAFETY

TRW requires AXAF subcontractors to comply with federal, state, and local safety regulations required by law. To ensure the safety of project personnel, TRW maintains the right to perform a safety review of subcontractor facilities. Equipment safety is ensured through the Product Assurance Requirements (PAR) document and quality requirements included in the subcontracts.

7.0 AXAF RADIATION SAFETY PLANNING

The TRW Space and Defense Radiation Safety Program is described in Health and Safety Standard Practice 7.1, "Ionizing Radiation control Program," and 7.2, "Safety Standards for Use of Ionizing Radiation." These documents implement the requirements of the Nuclear Regulatory Commission (NRC) and the State of California with respect to use of radioactive materials in California and at KSC. The TRW Radiation Safety committee reviews and approves radioactive material use by TRW employees and establishes radiation safety program policy within the TRW Space and Defense Sector.

ATTACHMENT I
COMMON USE MANAGEMENT SYSTEMS
HEALTH AND SAFETY MANUAL
"HEALTH AND SAFETY PROGRAM, 1.1"
28 SEPTEMBER 1990

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Space & Defense Sector

Health & Safety Manual



Subject Health & Safety Program

1.1

Approved

E. J. Hickey

DATE: September 28, 1990

Supersedes: December 15, 1986

1.0 PURPOSE

To describe the organization, objectives, and associated responsibilities of the Health & Safety Program.

2.0 APPLICABILITY

This policy applies to the groups using the Intergroup Functional Manuals as defined in Space & Defense Sector Policy 110 (Avionics & Surveillance Group, Electronic Systems Group, General Services Division, Space & Technology Group, and Systems Integration Group), hereinafter referred to in this policy as the company.

3.0 POLICY

- 3.1 It is the policy of the company to conduct an active Health & Safety Program to ensure that a safe, healthy working environment is provided for all employees consistent with applicable federal, state, and local safety, fire, and health codes.
- 3.2 A fundamental premise of the company policy is that the Health & Safety Program is a management program. That is, the primary responsibility for safety in the performance of operations rests with the vice presidents and general managers of each group and division. The effectiveness of the Health & Safety Program depends upon the extent to which such managers actively fulfill this responsibility. The effectiveness of the program further requires that Health & Safety be advised, and used as a management resource, early in the planning stages of proposals and project activities to ensure that occupational safety and health requirements and related cost/contractual considerations are adequately identified.

4.0 GENERAL

The Health & Safety Program is designed to include the participation of upper management in the formulation of health and safety policy and to involve company operation organizations and employees in such areas as hazard review, accident prevention, self-inspection of work areas, emergency support, etc. The Health & Safety Program lead executive for the company is the Vice President and General Manager of the General Services Division and includes the Intergroup Health and Safety Council, the central Health & Safety organization, group Health & Safety organizations, the company Radiation Safety Committee, and Group/Division Safety Committees.

The areas of major importance in the Health & Safety Program are summarized below, (company policies and procedures relating to these areas are contained in the Health & Safety Manual).

- 4.1 Health & Safety Reviews/Evaluations - Provides for policy compliance reviews and evaluations of company facilities, operations, and group safety programs in order to assure compliance with health and safety legal standards, contract requirements, and company policies. (See Health & Safety Policy 1.8, "Health & Safety Inspection Program")
- 4.2 Occupational Safety - Directed toward the prevention of accidents and injuries. Emphasis is on (1) engineering hazard review/analysis and studies of new facilities, test operations, and equipment and (2) the identification, analysis and correction of safety hazards. (See Health & Safety Policy 2.1, "Occupational Safety Program")

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- 4.3 Industrial Hygiene - Directed toward evaluating work environments and recommending corrective action to ensure that the health of employees is not adversely affected by elements of the work environment. Some considerations pertaining to industrial hygiene are: analysis of airborne contaminants and noise levels in the work area, design and operation of local exhaust ventilation systems, and use of respiratory protective equipment. (See Health & Safety Policy 3.1, "Industrial Hygiene Program")
- 4.4 Health Services - Includes: (1) operating Health Services Units located in various company buildings and staffed by Occupational Health Nurses; (2) providing definitive nursing care and primary medical management with medical and psychiatric care referrals appropriate for work-related injuries/illnesses; (3) performing health evaluations for employees returning from medical disability absences; (4) providing pre-placement health evaluations and drug testing; (5) providing or arranging for health evaluations for designated employees; and (6) maintaining medical records in compliance with legal requirements. (See Health & Safety Policy 4.1, "Health Services Program")
- 4.5 Fire Protection - Directed towards (1) life safety programs, (2) prevention and control of fires, and (3) prevention of damage to facilities and equipment through fire protection engineering in facility design and construction. Programs are established for control of flammable materials, high fire potential operations, and high value areas, as well as regular surveillance of company facilities and fire suppression equipment. (See Health & Safety Policy 5.1, "Fire Protection Program")
- 4.6 Emergency Support Service - Trains employees for response to emergency situations (for example, Emergency Assistance Team Program, Building Evacuation Drill Program and Earthquake Preparedness). Support is also provided to the sector Emergency Preparedness Program. (See Space and Defense Sector Policy 453, "Emergency Preparedness Program") This program also includes the Hazardous Materials Response Team which responds to emergencies involving hazardous substances.
- 4.7 Radiation Safety - Controls the use of radioactive materials, ionizing radiation-producing devices (x-ray machines, etc.) and non-ionizing radiation-producing devices (lasers, etc.) to prevent hazardous exposures. A Radiation Safety staff is maintained to: (1) provide appropriate technical guidance in the safe use of ionizing and non-ionizing radiation sources and devices, (2) train employees working with or near radiation, (3) perform testing and measurement of radiation sources and devices, and (4) assist management, as required, in projects involving the use of radiation. (See Section 7.0 of the Health & Safety Manual)
- 4.8 Hazardous Substance Control Program - Ensures that company and legal requirements are met regarding the identification, acquisition, movement, handling, documentation, and control of hazardous substances. Also provides for health evaluations and training of employees working with hazardous materials. This program also ensures that all legal requirements are met regarding employee and community right-to-know and that associated regulatory reports are filed in a timely manner.
- 4.9 Health & Safety Training - Directed toward ensuring that health and safety training is provided as required (a) by law and/or contract requirements and (b) so that employees have knowledge of legal requirements and can perform their tasks in a safe manner. (See Health & Safety Policy 1.11, "Health & Safety Training Programs")
- 4.10 Workers' Compensation Programs - Ensures that company and legal requirements are met regarding the treatment, reporting, recordkeeping, and case resolution for work-related injuries/illnesses.

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5.0 RESPONSIBILITIES

5.1 The responsibilities and functions of the Health and Safety Council, Group/Division Safety Committees, and Radiation Safety Committee are described in detail in policies 1.2, 1.3, and 1.5, respectively, of the Health & Safety Manual. However, in order to provide general understanding of the roles these organizations have within the company Health & Safety Program, their responsibilities are briefly stated below:

5.1.1 Health and Safety Council - Operates at the Intergroup Functional Management level to: (1) appoint a manager for the Health and Safety Manual along with reviewing and approving Health and Safety Policies for publication; (2) appointing subcommittees and/or working groups as appropriate; (3) ensuring the maintenance of health and safety programs and systems within their respective Groups; (4) maintaining functional interface with the Defense Plant Representative's Office (DPRO); and (5) providing a forum for exchange of health and safety information among the Groups. (See Health & Safety Policy 1.2, "Health and Safety Council")

5.1.2 Radiation Safety Committee - Operates at the Intergroup Functional Management level to: (1) advise management concerning radiological health matters; and (2) perform those tasks required by regulations governing the use of radioisotopes and as specified by applicable radioactive materials license(s) issued to the company. (See Health & Safety Policy 1.5, "Radiation Safety Committee")

5.1.3 Group/Division Safety Committee(s) - Established by group/division units as required to implement and monitor group/division safety programs in accordance with: (1) health and safety policy formulated by the Health and Safety Council, and (2) the requirements of the Health & Safety Manual. Additional safety committees may be established in specific organizations to be responsible for day-to-day operational surveillance relating to safety and accident prevention. (See Health & Safety Policy 1.3, "Group/Division Safety Committees")

5.2 The General Services Division (GSD) or Group Health & Safety Manager, or if none, the senior organizational manager at each geographical location or designee(s) is responsible for:

5.2.1 Developing and implementing the company's Health & Safety Program and providing the professional capability required to maintain, or support the maintenance of, procedures and services related to health and safety within the company.

5.2.2 Developing and maintaining the Health & Safety Manual.

5.2.3 Acting as the coordination point between the company and the Defense Plant Representative's Office (DPRO) in health and safety matters.

5.2.4 Providing coordination with local, state, and federal regulatory agencies, customer representatives, and insurance agencies on health and safety matters and providing appropriate reports as required.

5.2.5 Providing technical assistance and training to company organizations in matters of health and safety to ensure regulatory compliance and the safety of employees, facilities, and equipment.

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- 5.2.6 Maintaining accident reporting systems for accidents involving personal injury/illness and/or property damage and preparing appropriate reports for management and the Health and Safety Council.
- 5.2.7 Reviewing the effectiveness of and compliance with the Health & Safety Program and reporting the results to appropriate group management.
- 5.2.8 Providing assistance for the recognition, evaluation, control, and surveillance of potentially hazardous conditions and operations and for monitoring the effectiveness of these actions.
- 5.2.9 Developing criteria and requirements which will minimize employee accident/injury potential and hazardous substance exposure.
- 5.3 Group Vice Presidents and General Managers, or designee(s), are responsible for:
 - 5.3.1 Appointing a representative to serve on the Health and Safety Council.
 - 5.3.2 Ensuring compliance with health and safety contractual and legal requirements.
 - 5.3.3 Ensuring that the requirements of the Health & Safety Manual are met.
- 5.4 Cost center code managers or designated supervisors are responsible for:
 - 5.4.1 Ensuring that all personnel in their organizations are made aware of and comply with policies and practices described in the Health & Safety Manual.
 - 5.4.2 Ensuring that all personnel are properly trained in the safe performance of their duties and receive required specialized training. (See Health & Safety Manual, Health & Safety Training Program)
 - 5.4.3 Ensuring that facilities and equipment within their jurisdiction are maintained in safe operating condition and that adequate and appropriate safeguards are provided.
 - 5.4.4 Implementing methods and procedures for timely correction of unsafe or unhealthy conditions and work practices.
 - 5.4.5 Investigating work-related accidents/illnesses, incidents, and property damage which resulted or might have resulted in injury/illness; taking appropriate corrective action, and reporting results to Health & Safety as requested.
 - 5.4.6 Administering appropriate disciplinary action within their organization for violations of established safety practices and regulations.
 - 5.4.7 Ensuring that employees are assigned work tasks consistent with their known physical and health conditions.
 - 5.4.8 Requesting the early involvement and assistance of Health & Safety on any questions or problems relating to the health and safety of employees, their work environment (including new construction and modification of existing facilities), or operations.

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- 5.5 Employees are responsible for:
 - 5.5.1 Complying with all recommended/required safety practices applicable to each task undertaken.
 - 5.5.2 Requesting instruction from supervision if the safe performance of any task is not understood.
 - 5.5.3 Reporting to supervision any unsafe, or potentially unsafe, working conditions and any change in their health and/or physical conditions that could adversely affect safe work performance.
 - 5.5.4 Immediately reporting any work-related injury/illness or accident/incident, both to supervision and to the nearest Health Services Unit or site representative responsible for health and safety.
 - 5.5.5 Immediately reporting to supervision any incident involving property damage.

HEALTH AND SAFETY PROGRAM
FUNCTIONAL ORGANIZATION

